EVIDENCES OF THE EFFECT OF CHEMICO-PHYSICAL INFLUENCES IN THE EVOLUTION OF BRANCHIOPOD CRUSTACEANS.

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DURING the winter months *Eubranchipus vernalis* Verrill,[1] occurs near Maspeth, L. I., in immense numbers, in large communicating ponds containing clear, yellowish, fresh water. In January 1880 I found in a small and entirely isolated pool, less than a hundred paces from the above-mentioned place, a number of perfectly colorless, smaller, but sexually mature individuals of these branchiopod Crustaceans. The bottom of the pool is a white and very soft clay, and the water itself is of a milky color. I collected a number and observed the following differences:

A. Very few individuals of both sexes bearing, with the exception of the transparent body and the red furca of the post-abdomen, the same characters as Eubranchipus.

B. A great number of colorless individuals from fifteen to twenty-two mm. in length. These differ from the larger, red Eubranchipus, in the following particulars. Cephalic scute large and convex; basal joint of male clasper cylindrical; claspers crossing each other, short, tip of second joint with a blunt minute tooth; second joint more or less conical, tapering. A more full account I will soon give in Professor A. S. Packard's monograph on Phyllopod Crustaceans of the sexual organs, copulation and the biology of these colorless individuals.

C. A single specimen of male Chirocephalus.

D. A hermaphrodite. Sexual organs separate, both male and female claspers present.[2]

E. A single male individual with a minute tooth on the second joint of its right clasper; tooth wanting on the left. Left clasper in normal position, right clasper twisted around, thus apparently preventing the animal from using it in copulation. The tooth is probably a substitute for the distorted hook, and assumes its func-

[1] "Observations on phyllopod Crustacea of the family of Branchipidæ, with descriptions of some new genera and species." By A. E. Verrill, professor of zoölogy. 1869.

[2] I described this hermaphroditic form in AMERICAN NATURALIST, February, 1881, pages 136 to 139.

tion. This exemplifies Dr. Dohrn's theory[1] of the consecutiveness of functions whose bearings concern one and the same organ, brought about by evolution. I refer to papers by Professor Cope in the AMERICAN NATURALIST, "A review of the modern doctrine of evolution," etc.

Professor Moritz Wagner's migration theory,[2] as well as Dr. Charles Darwin's selection theory,[3] may be employed to explain the occurrence of the above-mentioned sets *A*, *B*, and probably also *C*.

First I must mention that, on keeping a number of Eubranchipus, male and female (the latter with ovaries filled and oviducts empty), together with a number of sets *A* and *B*, males and females (female in the same condition), during five days, I could never observe a single case of crossing; on the contrary, the two (red and white) avoided each other and only copulated among themselves. Now, as to set *A*, I consider them to be the first generation of Eubranchipus, brought along with mud into the little clay pool, by water birds, from the neighboring larger ponds.[4] The transparency of their bodies was produced by the chemico-physical influence[5] of the little clay pool, and not by "mimicry." As the pool is an isolated one, there was no chance for the absorbing or obliterating influences of crossing with the original red Eubranchipus; consequently the offspring of this new, colorless race, influenced by different factors, were liable to submit to still further evolutionary transformations which I believe have been realized in set *B*: The animal gradually degenerated into a much smaller one with the above-mentioned characters. The factor that produced it was a conservative one, favoring the preservation of

[1] "Der Ursprung der Wirbelthiere und das Princip des Functionswechsels." Genealogische Skizzen von Dr. Anton Dohrn. 1875.

[2] "Die Darwin'sche Theorie und das Migrationsgesetz der Organismen." Von Dr. Moritz Wagner. 1868. The refutation of Wagner's law of migration was attempted by my former tutor, Professor Dr. Aug. Weismann ("Ueber den Einfluss der Isolirung auf die Artbildung," 1872); owing to a misconception of Wagner's paper he combined his theory with Darwin's selection theory, whilst both theories considerably deviate from each other as regards the compelling mechanical cause. See also *Kosmos*, IV, April, 1880: "Ueber die Entstehung der Arten durch Absonderung." Von Moritz Wagner.

[3] "On the Origin of Species by Means of Natural Selection." 1859.

[4] J. A. Ryder in AMER. NAT., XII, page 703.

[5] See also papers by W. J. Schmankewitsch in *Zeit. für wiss. Zool.*, 1872, 1875 and 1877.

this new species.[1] The factor that produced the individual *E* was a compelling mechanical cause originating in a pathological condition. According to Dr. Darwin, the mechanical cause enters into activity with the appearance of "favorably varying" individuals whose morphological deviations are either inherited or adapted. As to *C*, the genus Chirocephalus, I have reason to suspect in the lobed and prolonged frontal tentacles only a product caused by either chemico-physical or a sudden change in climatological influences. The successive appearance of Chirocephalus and Streptocephalus in one and the same pond near Woodbury, N. J.,[2] rather strengthens my assumption.[3]

The hermaphroditic form *D* shows characters closely relating it to set *A*. From the study of comparative anatomy it follows that hermaphroditism, *i. e.*, the coëxistence of both male and female sexual organs in one individual, is the primitive condition of sexual differentiation, which may in time be followed by a complete separation of the sexes.[4] Hermaphroditism and parthenogenesis can be regarded as cases of atavism—as a reoccurrence of former, primitive conditions. Further progress in differentiation of the sexual conditions, Haeckel ascribes to "division of labor" (Arbeitstheilung). The bilateralism in this hermaphrodite indicates close relationship and coördination between the sexual organs and auxilliary copulation organs. According to Dr. Chas. S. Minot's theory,[5] it is possible that a male genoblast was formed by the splitting of a neutral cell on one side, and a female genoblast in the same manner on the other side of the post-abdomen at an early larval stage, and that then, as the animal became gradually more developed, the second pair of antennæ (not hitherto sexually distinguishable) transformed themselves symmetrically in accordance with the bilateral position of the genital glands and their exits. Unfortunately we are absolutely ignorant of the conditions which cause an animal, when capable of making genoblasts, to produce either male, female or hermaphrodite.

[1] Professor Huxley's "The Crayfish:" "In a strictly morphological sense, a *species* is simply an assemblage of individuals which agree with one another and differ from the rest of the living world in the sum of their morphological characters."

[2] J. A. Ryder, *op citat.*

[3] It is not impossible that branchiopod Crustaceans are liable to produce seasonal dimorphic individuals, a parallel to cases observed in Lepidoptera, according to Professor Sam. H. Scudder, Professor A. Weismann and others.

[4] Professor Ernst Haeckel's "Anthropogenie," pages 395, 681, etc.

[5] AMER. NAT., XIV, Feb., 1880.